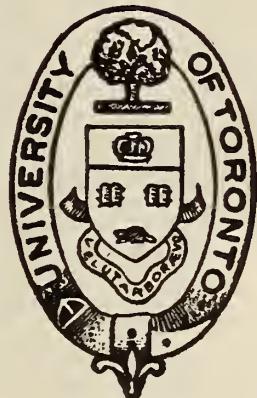


UNIVERSITY OF TORONTO  
(THE PROVINCIAL UNIVERSITY OF ONTARIO)

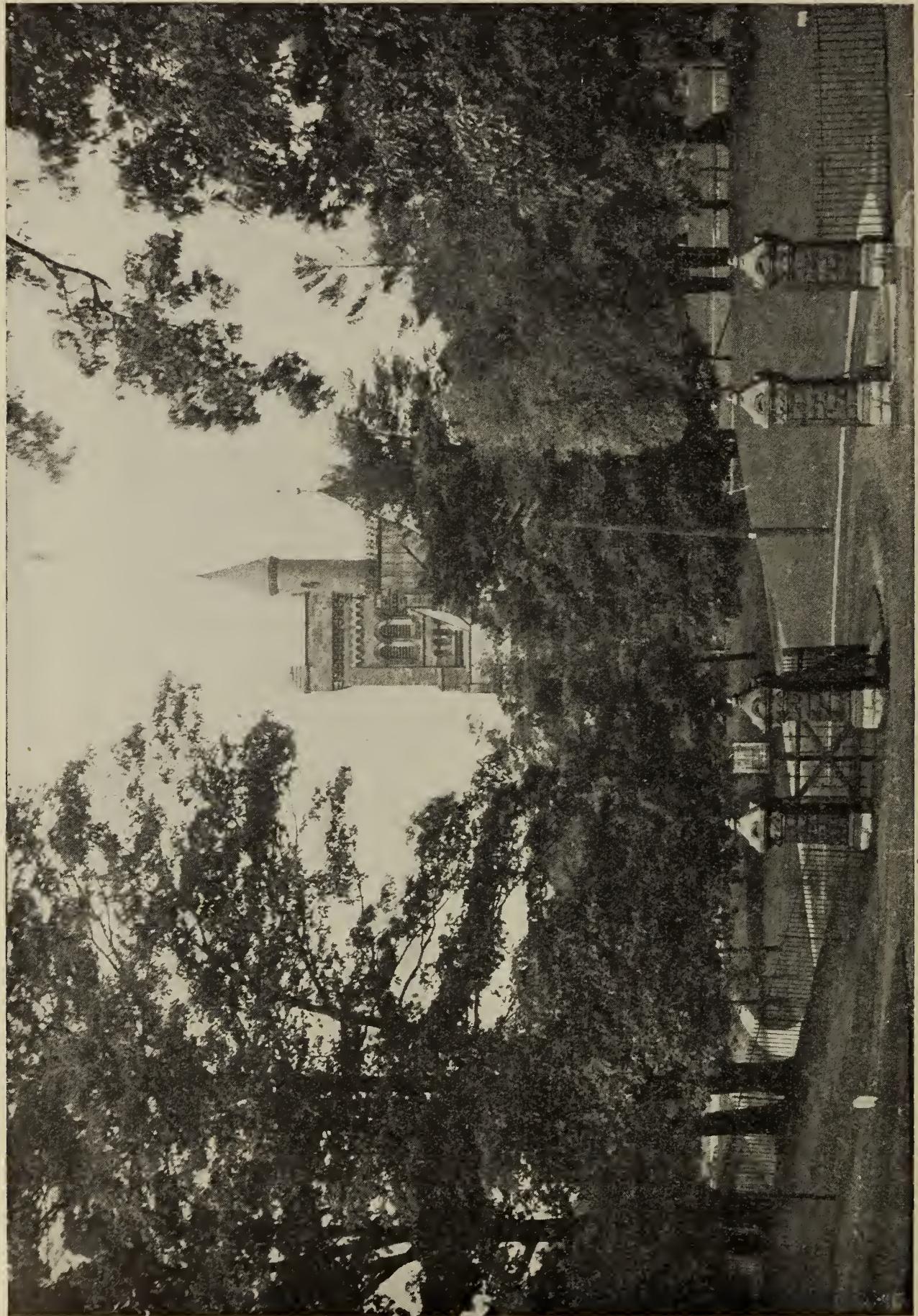


Opportunities  
for  
Graduates in Science  
in the  
Faculty of Arts

*Copies of this bulletin may be obtained, free, on application to the Department of University Extension, University of Toronto, Toronto.*

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EASTERN ENTRANCE TO UNIVERSITY GROUNDS.

# INFORMATION REGARDING THE SCIENCE COURSES IN THE FACULTY OF ARTS IN THE UNIVERSITY OF TORONTO AND OPPORTUNITIES OPEN TO GRADUATES IN THESE COURSES

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The science staff of the Faculty of Arts of the University of Toronto believes that a brief statement in regard to the science courses, and the opportunities available to students graduating in these courses, would be useful to the teachers and students of the secondary schools of the Province.

The attention of the incoming student is drawn to the fact that the entrance conditions required for all the science courses are much the same. Prospective students should read carefully the entrance requirements as set forth in detail at the end of this pamphlet. It is desirable that in the high schools a good deal of attention be devoted to English language and literature and to such other languages as Latin, French, and German; in the biological sciences an elementary acquaintance with Greek, although not necessary, is of advantage. A good training in languages and a thorough grounding in mathematics is very desirable for all such students.

An outline of the salient features of the various science courses is given and, although the aim of science teaching is the training of men and women and not the making of technicians, a survey of the vocational outlook is added.

The notice of the student is particularly drawn to the fact that for most of the courses the work of the First Year in the University is identical, so that the student has not to make a choice until the end of his First Year.

## BIOCHEMISTRY

Biochemistry treats of the chemical and physico-chemical structure of living organisms, the reactions which underlie the various manifestations of life, the products characteristic of the vital process, the nutritional requirements of animals and plants, and the chemical and physico-chemical methods that have been applied to biological problems. The subject is included in the honour courses in chemistry, biology, household science, and biology and medicine; but is covered more fully in the honour course in physiology and biochemistry, in which course the student is given the option of specializing in one or other of its two principal subjects.

The following are among the opportunities open to those with a biochemical training:

- (1) Graduate work in this or other universities leading to the higher academic degrees.
- (2) Teaching or research positions in university departments of biochemistry, physiology, pharmacology, and related subjects.
- (3) Positions as biochemists in the laboratories of hospitals, and of medical, veterinary, and dental schools, or research institutes.
- (4) Similar positions in the various municipal, provincial, and federal health departments.
- (5) Appointments under the Department of Agriculture and other Government bureaux.
- (6) Positions as food-chemists or as nutrition experts in institutions of various kinds.
- (7) Positions as biochemists in the food products, pharmaceutical, fermentation and numerous other industries which handle biological materials or employ biochemical processes.

## BOTANY

The course in Botany has been planned to enable a student to prepare himself for the original investigation of the diverse problems presented by plant life. These problems fall naturally into a number of groups: the form of the plant (morphology); classification and inter-relationships (taxonomy); anatomical structure; physiology (which includes the physics and chemistry of the life processes); the cause and control of disease (plant pathology); the breeding of plants and the laws governing the inheritance of their characteristics; and the ecology of plants or working relationships between the plants themselves and their surroundings.

The solution of the problems requires a sound fundamental training in branches of science other than Botany, and students who pursue the Botany course spend considerable time acquiring the fundamentals of Physics, Chemistry, Zoology, and Geology. The result is that those who plan to enter the teaching profession in a science department of high school, collegiate institute, or college will find the Botany course an excellent preparation for such work.

While numbers of graduates have entered this field, the proportion doing so has become smaller owing to the increasing demand from other directions for professional botanists. Many have taken government positions in Canada, and some in other parts of the Empire, in the United States and other countries. The number and the diversity of

the demands for trained botanists have been constantly increasing of late years. Many of those who have been trained in Botany at Toronto are at present employed by various governments as pathologists, investigating and controlling disease in agricultural crops and in the forests. Several others have been placed in charge of seed-testing laboratories or have taken positions as microscopists, for which their work on the microscopic anatomy of plants has admirably fitted them. Again, we are asked from time to time for trained workers in wood technology, plant breeding, and botanical survey work.

To fit students for the best of these positions graduate research work is necessary. Honour graduates in Botany are eligible for admission to such training, leading to higher degrees, not only in our own graduate school, but in those of all other universities. For those who excel, fellowships or teaching assistantships are available. Of these students many are filling outstanding positions of the nature referred to above while others are occupying professional posts in universities.

The demand for trained botanists has up to the present been, in our experience, at least equal to the supply, and shows signs of increasing, not only along the lines indicated but also in connection with various industries such as pulp and paper companies, rubber companies, and other industries dealing with plant products.

Notwithstanding the increasing variety and importance of the opportunities to enter a professional career in Botany the curriculum has not been narrowly adapted to professional purposes. Philosophical values have everywhere been considered of equal or superior importance. The course is, therefore, planned to develop those habits of thought which are indispensable to the scientist while encouraging the humanistic outlook natural to the student of living things. This branch of science thus offers one among many opportunities to the intending student who contemplates a university career rather for the sake of cultivating his mind than as a means of equipping himself to make a living.

## CHEMISTRY

*Courses.*—In the Faculty of Arts this Department provides two honour courses for the student who wishes to lay a broad and secure foundation for graduate work in chemistry. These are the courses described in the University Calendar as (i) "Chemistry and Mineralogy, Div. I," and (ii) "Chemistry." In both of these courses chemistry forms the major part of the work. Courses leading to the degrees of Master of Arts and Doctor of Philosophy are provided under the School of Graduate Studies.

*Subjects.*—In the lower years enough lectures and laboratory work are provided in physics, biology, mineralogy, and geology to show the connection between chemistry and the other sciences. Throughout the four undergraduate years special attention is paid to the application of mathematics to the solution of chemical problems. By this means many of the apparent difficulties both of advanced chemistry and of higher mathematics are removed. In every year of the course the students are given ample opportunity for learning to read scientific French and German and thus, at the time of graduation, they have acquired a very valuable reading knowledge of these two languages.

*Lectures.*—The lectures in chemistry are few in number and are mainly devoted to physical and organic chemistry. They deal with fundamental conceptions rather than with direct practical applications of chemistry, for the Department is convinced not only that this is as much as can be accomplished thoroughly in four years, but also that it affords the best training for whatever line of specialization the student may be called upon to follow after graduation.

*Laboratory Work.*—Special stress is laid on laboratory work, particularly on quantitative measurements; for it is only by such work that the student can be led to comprehend the nature of the scientific method of investigation. In the fourth year the students are introduced to the methods of chemical research, and in some instances obtain results which are accepted for publication in scientific journals. The object of this work, however, is not to obtain as many results as possible, but rather to give the beginner experience and confidence in applying the principles of his science to the concrete problems presented to him for solution. These problems are selected from the field of "pure" chemistry, and, although they have no direct bearing on the industrial application of the science, yet, in the words of the Royal Commission on University Education in London, "the effect in relation to the profession or calling which the student has in view is that he brings to it not only the discipline, training, knowledge, and resourcefulness he has acquired; but also the intellectual mastery of the principles involved, which enables him throughout his life to appreciate and apply all advances in science that bear upon it." The prosecution of original research is also required from all candidates for the graduate degrees.

*Careers Open to Graduates.*—The careers open to students taking the courses described above may be seen from an analysis of the subsequent careers of past graduates of the Department. Of the graduates from 1891 to 1923, over sixty per cent. obtained a post-graduate degree, including 32 Ph.D.'s, of which 16 were conferred by this University. Of 176 graduates concerning whom information is at hand, 27 became

professors and 6 lecturers in universities of Canada, England, and the United States; two are professors in Macdonald College; 32 became teachers in secondary schools; 18 entered the scientific branches of the civil service; 26 are working in research laboratories connected with chemical industries; and 32 occupy administrative positions in business firms. Besides these, there are four farmers and ranchers, 2 physicians, 2 engineers, 3 journalists, one school inspector, 2 barristers, and one broker; 18 were still graduate students at the time the survey was made.

## FOOD CHEMISTRY

In the Department of Food Chemistry instruction is given to the students of the courses in household science and in household economics, to students of the pass course, and also to graduates and others who wish to make a study of the chemistry of foods and of nutrition.

The training that is offered follows instruction in elementary science, especially in inorganic and simple organic chemistry, and is particularly adapted to the needs of young women who are specializing in the various branches of household science work.

Students graduating after instruction in this Department are ready to proceed in various lines of chemical work, particularly those concerned with the analysis and composition of foods and with the chemical nature of nutrition. They are, therefore, prepared for work in factories, in academic institutions, and in laboratories as food analysts, as laboratory assistants to doctors, etc.

Graduates who have received instruction in the Department of Food Chemistry are now engaged as chemists and as clinical workers in Departments of Public Health, in hospital laboratories, in Research laboratories and in commercial testing laboratories.

## GEOLOGY

The study of geology demands a preliminary knowledge of the fundamental sciences—physics, chemistry, and biology. The work of the first two years is designed, therefore, to include as much as possible of these subjects while that of the third and fourth years is more specialized.

The graduating department of "Geology and Mineralogy" is the most general course leading to a degree in geology, but the department of "Chemistry, Mineralogy II, and Geology" embraces considerable geology with more chemistry and less biology. A course in Physics and Geology has recently been introduced to train men in the fundamentals of geophysics.

Courses in geology offer the following advantages:

(1) As the courses embrace the fundamental sciences as well as geology proper, they form an excellent preparation for those desiring to teach. Many graduates of the department are now engaged in the high schools of the Province and others occupy positions in institutions of higher learning both in Canada and abroad.

(2) Graduates in geology are eligible for positions on government surveys in Canada or in other countries. Many graduates of the department now occupy important governmental positions of this kind.

(3) The courses in geology qualify men for positions with prospecting, mining, and oil companies.

(4) Geology is an excellent preparation for men intending to pursue mining engineering.

(5) As geology is broad in scope, including the cognate sciences, and dealing with the general history of the earth, it is an excellent preparation for many of the professions and for business of certain kinds.

(6) Graduates in geology are accepted as candidates for the higher degrees at Toronto and at any other university.

(7) Graduates in Physics and Geology should find positions in geophysics with mining companies or in the government service as seismologists.

## HOUSEHOLD SCIENCE

In household science there are two honour courses leading to the degree of Bachelor of Arts, (a) Household Science, (b) Household Economics.

In courses especially designed for young women, it is desirable that the training should offer an all-round development, and, therefore, approximately one-third of each of the second, third and fourth years is devoted to more general subjects, such as English, French or German, ethics, economics, etc.

As a knowledge of chemistry, physics, and biology is essential, the first year is devoted almost entirely to a study of these fundamental sciences, and, in fact, chemistry is continued throughout the four years.

The subject of household science includes a theoretical and practical study of textiles, household management, economics of the household, foods and dietetics.

Of the various fields of work open to graduates of these courses, the following are the more important:

(1) Teaching—household science in high schools, collegiate institutes, technical schools, colleges, etc.

Graduation from either of the above courses, provided the candidate secures the required standing, is accepted by the Department of Education of Ontario as the academic standing for a specialist certificate in household science.

(2) Hospital Dietetics—On the completion of a post-graduate course in practical dietetics in a hospital, the graduate is qualified for a position as:

(a) A hospital dietitian in charge of special diets.

(b) An administrative dietitian in a hospital.

(c) A consulting dietitian—to co-operate with the medical profession.

(3) Commercial dietetics—executive dietitians in hotels, industrial and business houses, and managers of restaurants, tea rooms, etc.

(4) Journalism—magazine articles on nutrition and dietetics.

(5) Laboratory positions:

(a) Food and textile analyst for commercial firms.

(b) Laboratory assistant to doctors.

(c) Laboratory assistants in medical and dental research, etc.

In addition to the two courses leading to the degree of Bachelor of Arts, the University offers a course in household science leading to the degree of Bachelor of Household Science. This course has been arranged to provide opportunities for the study of household science for candidates who have not had courses in Latin, such as graduates of technical schools.

## MATHEMATICS

The advanced courses in mathematics, leading to the bachelor's degree, prepare the student, in whole or in part, for the following occupations:

(1) *Secondary School Teacher*.—Graduation with honours in the special course in mathematics is accepted by the Ontario Department of Education as academic qualification for standing as mathematical specialist.

(2) *Actuary*.—An actuary is a person skilled in calculations which involve the probabilities of life and death. These are determined from the records of many thousands of lives, and on them as a basis an elaborate mathematical theory has been built. This is applied to the business of a life insurance company by the company's actuarial staff. To qualify as an actuary one must pass the very difficult examinations of one of the great actuarial societies. The University of Toronto provides instruction in the mathematical subjects of these examinations.

(3) *Astronomer*.—In Canada there are two large astronomical observatories, in which there are openings from time to time. For almost all the positions in these institutions a training in advanced mathematics is indispensable.

(4) *Geodesist*.—The geodetic survey of Canada carried on by the Dominion Government requires many scientifically trained men. The measurements of the survey are of very high precision, and the operations are on such a large scale that they lead to the determination of the shape and size of the earth.

(5) *Advanced Worker in Physics or Engineering*.—Until recent years most advances in the exact sciences have been made by European research workers. Latterly, however, American scholars are creating an enviable reputation for themselves in this field.

(6) *College Teaching*.—Many universities and colleges are being established and are passing through the early stages of their development, and the number of posts in prospect is by no means small.

In addition, a course in mathematics provides important cultural advantages, particularly in developing precision of thought. Several men prominent in the business and commercial life of Canada have had the advantage of a training in honour mathematics at the University of Toronto.

## MINERALOGY

Honour students in Chemistry, Mineralogy and Geology, and in Geology and Mineralogy, receive a thorough grounding in the various branches of mineralogy during the last three years of their courses. In addition they are given such work in the cognate subjects of chemistry, biology, geology, and physics as will enable them to apply these to the solution of problems in mineralogy and petrography.

From the experience of graduates this training may be looked upon as an introduction to the following lines of work:

(1) With supplemental training in mining engineering good openings are presented in the mining industry in all parts of the world.

(2) Graduates with the necessary honour standing are accepted as specialists in science in the high schools and collegiate institutes of Ontario.

(3) Graduates are accepted by this University as well as by all universities for research work proceeding to advanced degrees.

(4) Students in mineralogy are accepted for field work with bureaux of mines and mineralogical and geological surveys. Graduates, particularly those who have continued in research work, have obtained permanent employment with such organizations.

(5) A graduate who has obtained the necessary experience by field work and laboratory research is prepared to report on economic mineral deposits.

## PHYSICS

In the honour courses in which a student specializes in physics, including Division II of the Mathematics and Physics course, the courses in Physics, Physics and Chemistry, and Physics and Geology, he is given during his four years a thorough grounding in all the branches of theoretical and experimental physics, together with a good introduction to the higher branches of mathematical physics.

A graduate of good standing in this Department should be capable not only of teaching intelligently the various branches of physics, but also of proceeding with graduate work in any of the leading universities of the world.

The actual experience of those who have taken these courses justifies the following outline of possible openings for graduates:

(1) Graduates obtaining the necessary honour standing are accepted as specialists in mathematics and physics in the high schools and collegiate institutes of Ontario. Anyone with an aptitude for teaching should not overlook this very substantial and honourable profession.

(2) The graduate is in an excellent position to take advantage of opportunities for continuing pure scientific research leading to the doctor's degree and then to the higher academic positions. The new courses of Physics and Chemistry and Physics and Geology are specially designed for the objectives outlined in this section and in the two following sections.

(3) The Department is constantly being asked for graduates to undertake research work with large industrial corporations, such as the General Electric Company, the large rubber companies, etc. These positions often lead to exceedingly good posts as manufacturing managers.

(4) Many graduates are now occupying influential positions in various departments of the civil service as, for instance, in the bureau of standards, the bureau of mines, experimental farms, the meteorological service, the astronomical observatories, and the topographical and geophysical surveys. In many cases these are essentially research positions and may often be compared, in respect of opportunities offered, with positions such as professorships in the universities.

(5) Students intending ultimately to take a course in law should not lose sight of the exceptional mental training offered by such courses as

physics in preparing them for their future careers. Especially is this true of men intending to specialize in such a department as industrial, technical, patent, or corporation law.

(6) The preceding paragraph applies with equal force to those who intend to enter general business, including technical and trade journalism.

(7) Graduates are especially well fitted for taking up advanced courses in mechanical, civil, and electrical engineering, and engineering research.

## PHYSIOLOGY

There are two groups of honour students in physiology: first, those taking the combined course in arts and medicine (B. & M.); and, secondly, those taking physiology and biochemistry purely as arts subjects (P. & B.). Students taking the biology and medicine course have the advantage over medical students of an extra year devoted practically entirely to the study of advanced physiology and biochemistry. By this extra year of work these students are in a decidedly better position than are regular medical students to undertake the study of medicine and surgery along modern scientific lines. Having completed their arts course, they enter the fourth year of the six-year course in medicine, having therefore taken four years to cover the work of the first three years in medicine. Quite apart from the undoubted advantage of this extra year of instruction, these men, by having an arts degree in a science subject, will receive more favourable consideration than those having no such degree, in the filling of the various hospital and university appointments, here and elsewhere.

Students taking physiology and biochemistry purely as arts subjects do so with the intention either of entering a career in teaching in these subjects or, in the case of biochemistry at least, of filling one of the various industrial positions that are coming to be available in work in this field; for example, the various agricultural bureaux and the patent food manufacturers and similar institutions are employing trained biochemists as experts in their work. There is no doubt that in the near future the demand for men with proper training in biochemistry and in the related subject of physiology will be considerably increased.

In connection with both those categories of students it should be pointed out that there are at present many more university teaching and research positions offered in the field of physiology and biochemistry than there are adequately trained men and women to fill.

## ZOOLOGY

In the preparatory stages as represented by the secondary schools a broad training is desirable. This implies, in general terms, adequate attention to mathematics, physics, and chemistry, on the one hand, and Latin (or Greek) and the modern languages, especially French and German, on the other. Since in practice the high school programme usually demands some degree of specialization, it is not possible for the pupil to include in his studies all those subjects which are of value. Hence, it may be pointed out that the better the pupil is trained in respect of these groups of subjects the better qualified he will be for zoological work. A pupil whose training is chiefly in the languages will have an advantage in the more descriptive part of zoology, natural history and classification, while one better trained in mathematics and physical science will have an advantage in experimental work and in professional fields where such work is implied. Proficiency in drawing and colouring is of value, as is also personal interest in some particular group of animals or in natural history.

The general outlook in the zoological branches may be summarized as follows:

(1) Opportunities in other institutions in which research and teaching, or research alone, are features, are best reached through the undergraduate university course, followed after graduation in arts by research leading to a higher degree. Some students, however, prefer complete or partial professional training in medicine or engineering after graduation in arts, in which case research and laboratory positions may be obtained after preparation in the more applied branches.

(2) Sanitary service, apart from medicine, is undergoing some development in Canada, as it has already elsewhere, in connection with engineering. The opportunities in this field should be especially good for arts graduates who, in addition to training in the fundamental sciences, have a competent knowledge of zoology, botany, bacteriology, and hygiene.

(3) The government service is open to graduates through various channels. For administrative work in connection with agriculture, fisheries, forestry, and conservation, university training is especially advantageous if it includes the elements of the sciences, with particular reference, in the branches here mentioned, to zoology and botany. On the technical side the opportunities available are for the most part in connection with experimental farms, government surveys, including survey expeditions, marine and fresh-water fisheries, and, to some extent, parks, forest and conservation service. The University offers special facilities for scientific research in fisheries problems and technical training

for students entering this branch of service. The work is organized in co-operation with the Dominion and Provincial governments. There are also special facilities for scientific animal breeding, the outlook for which in Canada is promising.

(4) Because of the intimate relation existing between the zoological work of the University and that of the Royal Ontario Museum of Zoology there are available to zoological students exceptional opportunities to enter either the scientific or technical branches of museum work.

(5) Commercial work in the zoological branches is largely concerned with industries based on the utilization of animal products. In relation to the practice of agriculture it is unfortunate that students from rural districts rarely regard the science courses of the university as being of value for practical farming in the same way as for academic and professional life. Now that the fundamental importance of agriculture is becoming generally recognized, its scientific and technical organization will undoubtedly proceed at a more rapid rate. The active co-operation of graduates both of the university and the agricultural college is especially needed in Canada to place the industry in the high position it should occupy, both as a productive enterprise and in the national esteem. Attention is also directed to the increasing importance of fur-farming in Canada.

(6) The professional outlook in relation to zoological courses, and apart from teaching, is chiefly in the direction of medicine and certain of its specialties. The latter include public health work, sanitary inspection, industrial hygiene, psychiatry, and social service, in all of which opportunities are available, especially to graduates in medicine who have had a preliminary arts course in the sciences.

(7) The higher of the secondary schools, collegiate institutes, colleges, and in some cases universities, require teachers capable of handling the elements of all or several of the recognized sciences.

## ENTRANCE REQUIREMENTS, 1928-29

### ADMISSION TO AN HONOUR COURSE

A candidate for admission to the First Year of an Honour Course must present, in addition to complete Pass Matriculation, certificates giving him credit at Honour Matriculation in the five subjects prescribed below for the Honour Course which he wishes to enter.

NOTE—*The term "additional subject" includes any one of English, History, Greek, French, German, Italian, Spanish, Trigonometry, Physics, Zoology, Botany, Chemistry.*

CLASSICS:—Greek; Latin; Mathematics (Algebra and Geometry); together with two additional subjects, one of which should be French or German.

FRENCH, GREEK AND LATIN:—Latin; Mathematics (Algebra and Geometry); two of Greek, English, French; together with an additional subject.

MODERN LANGUAGES:—Latin; Mathematics (Algebra and Geometry); two of German, French, Italian, Spanish; together with an additional subject.

ENGLISH AND HISTORY:—Latin; Mathematics (Algebra and Geometry); two of Greek, English, German, French; together with an additional subject.

\*MODERN HISTORY: } Latin; Mathematics (Algebra and Geometry); History;  
\*POLITICAL SCIENCE: } French or German; together with an additional subject.

†PHILOSOPHY } Latin; Mathematics (Algebra and Geometry); two of  
PHILOSOPHY (ENGLISH OR } English, History, Greek or German or French; together  
HISTORY OPTION): } with an additional subject.

\*PSYCHOLOGY:—Latin; Mathematics (Algebra and Geometry); two of English, French, German; and one of Physics, Zoology, Botany, Chemistry.

MATHEMATICS: } Latin; Mathematics (Algebra and Geometry, Trigo-  
MATHEMATICS AND PHYSICS: } nometry); Physics; and French or German.

PHYSICS AND GEOLOGY:

PHYSICS AND CHEMISTRY: } Latin; Mathematics (Algebra and Geometry, Trigono-  
metry); Physics or Chemistry; and French or German.

PHYSICS:

BIOLOGY:

PHYSIOLOGY AND BIOCHEMISTRY:

BIOLOGICAL AND MEDICAL SCIENCES:

CHEMISTRY:

CHEMISTRY, MINERALOGY AND

GEOLGY:

GEOLOGY AND MINERALOGY:

SCIENCE (GENERAL):

HOUSEHOLD SCIENCE:

HOUSEHOLD ECONOMICS—Latin; Mathematics (Algebra and Geometry); two of

English, French or German, Physics, Zoology, Botany, Chemistry; together with an additional subject; the candidate is recommended to take French or German and a science.

Candidates planning to enter the Honour Mathematics course are recommended to take the Solid Geometry option in Honour Matriculation Geometry.

Candidates planning to enter those Honour courses in which Scientific German is compulsory are recommended to commence the study of German in the schools, and, if possible, to obtain at least Pass Matriculation standing in that language before entering the University.

\*A student may qualify at the Honour Matriculation examination for admission to the Second Year of this course by obtaining complete standing in the First Year of the Pass Course with an average at one examination of at least sixty-six per cent. in four subjects of which two must be taken from Latin, French or German or Greek, Mathematics (Algebra and Geometry); the Honour Matriculation certificates submitted under this section must have been obtained in one or at most two years.

†A student may qualify at the Honour Matriculation examination for admission to the Second Year of this course by obtaining complete standing in the First Year of the Pass Course with an average of at least sixty per cent. in four subjects.



THE SOLDIERS' TOWER.